Space Weather Technical Forecast

Issued on Friday 8 November 2024 at 01:22 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Moderate solar activity with a chance of X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with several M-class flares. A peak flare of M2.7 was observed at 07/0754 UTC from AR3889.

There are currently nine sunspot regions on the visible disc, including one unnumbered group. The three most actively flaring regions (AR3883, AR3886 and AR3889) all lie in the southern hemisphere. AR3883, in the south-centre disc is now classified as Fhi/beta-gamma-delta, having elongated through the day while maintaining a small delta spot. AR3889 in the far southeast appears to be a moderately-large group with a cluster of mature spots. It is still too foreshortened in available imagery to confidently determine its magnetic configuration, but was actively flaring during the period. The remaining sunspot regions are smaller and more magnetically simple and generally either stable or in decay.

No Earth directed CMEs (Coronal Mass Ejections) were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds as measured at L1 by ACE/DSCOVR were generally between 380-410 km/s until 07/1422 UTC when a weak CME arrived (most likely originating on the 4th), with the wind speed then increasing to peak at 448km/s at 07/1610 UTC. Later the wind speed declined to end the day around 350 km/s. Density was below average until after 07/0900 UTC when values increased to become average, then increasing to above average after the CME arrival, reaching a peak of 46 ppcc at 07/1529 UTC. Late evening the density rapidly decreased, ending the day at average levels. The Interplanetary Magnetic Field (IMF), Bt, was predominantly weakly, but temporarily reached moderate levels (8 nT) between 07/1738-2218 UTC. The north-south component, Bz, was mostly weakly negative, reaching - 6nT at 07/1755 UTC. Phi angle was variable and erratic initially, then settled to become generally positive. Geomagnetic Activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 remained at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was at background to Moderate levels for much of the time, but temporary increased to reach High levels, peaking at 1292 pfu at 07/1650 UTC. The associated 24-hour fluence was well below the Active threshold, with 1.5e7 integrated flux observed at 08/0001UTC.

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Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is forecast to continue, with occasional M-class flares expected and a chance of isolated X-class flares, with AR3883 and AR3889 currently the most likely sources.

Solar Wind / Geomagnetic Activity: A minor CME enhancement is possible at Earth early today (08 Nov) but with low confidence given that only a glancing impact is expected.

Solar winds are currently at normal background levels. A weak HSS enhancement is considered likely later today (08 Nov) or on Day 2 (09 Nov), with Slightly elevated wind speeds at peak. There is a chance for further possible HSS influence to bring Slightly elevated or Elevated levels on Days 2 and 3 (09 and 10 Nov) from a larger but much more southerly located coronal hole.

Mainly Quiet to Unsettled (Kp 1-3) activity is expected, but with isolated Active (Kp 4) intervals likely due to occasional HSS and CME influences, with a slight chance of G1/Minor (Kp 5) geomagnetic storms until late day 3 (10th).

Energetic Particles / Solar Radiation: High energy proton flux at GOES-18 is at normal background levels. There is a slight chance of S1/Minor Proton Storms or greater on Days 1-2 (08-09 Nov), rising to a chance from Day 3 (10 Nov) as the significant regions on the facing-disc rotate into more geo-effective positions. The high energy electron flux is expected to be mainly Background to Moderate initially, later increasing to mostly Moderate levels and perhaps temporarily touching High levels at the peak of diurnal cycles. The associated fluence is excepted to persist below Active levels.

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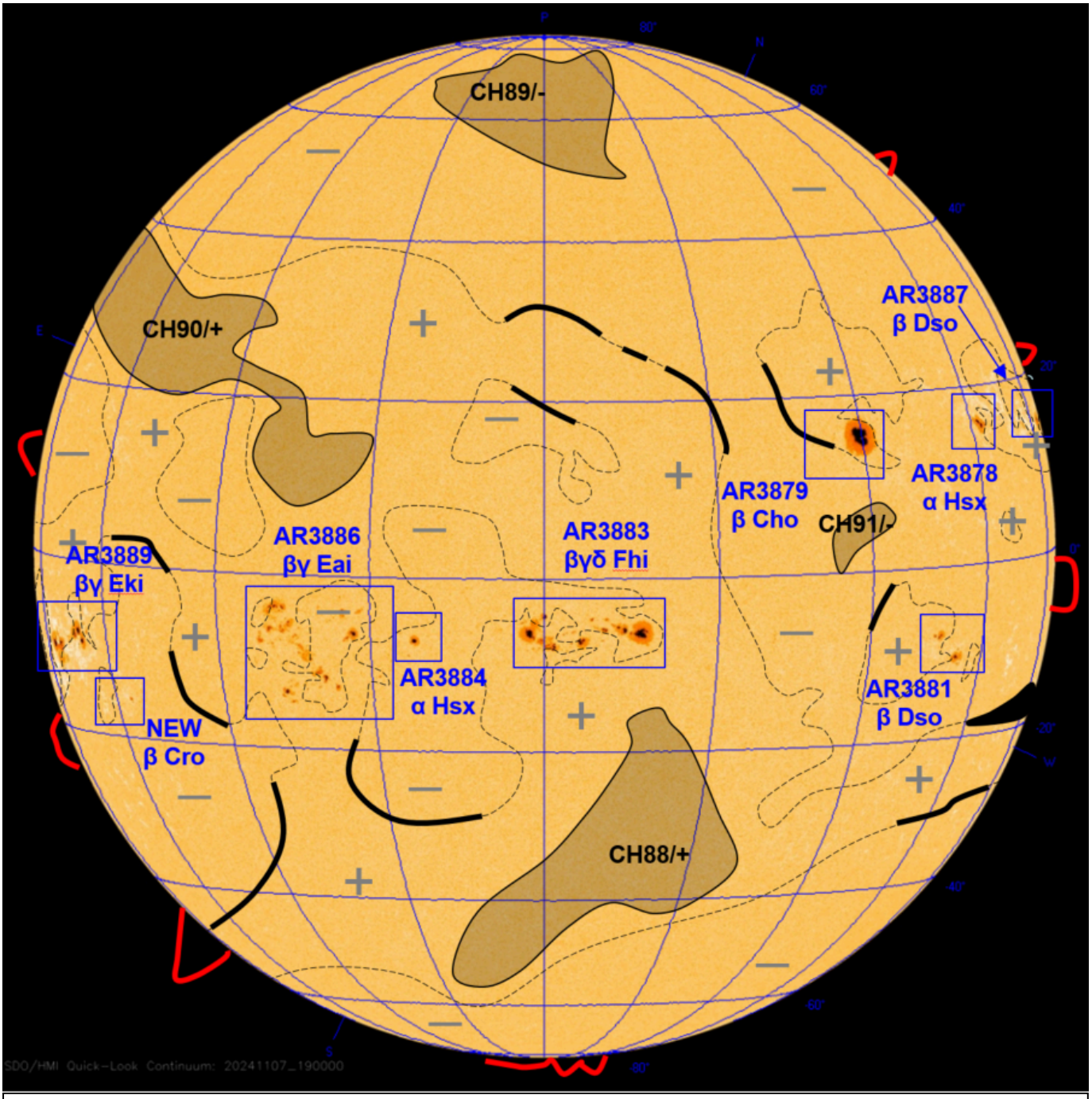
Figure 1: Synoptic map valid 07/1900 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

The weak CME that arrived on the 7th is likely to be associated with the M3.8 flare from AR3883 at 04/0141UTC.

Solar Orbiter detected a moderate CME enhancement around 07/0400 UTC. The current location of the satellite is 7 degrees East of the Earth-Sun line at 0.71AU and therefore could provide useful insight into any potentially Earth-directed CMEs. Based on previously modelling it is considered likely that this feature is related to the lift-off associated with mid-high level C-class flaring of AR3883 around 05/0000 UTC. If this is the source of the enhancement detected at Solar Orbiter earlier on 07 Nov, then there is a chance of a flanking impact at Earth early today (08 Nov). Confidence in this analysis is only moderate given uncertainties in the initial CME analysis and also the small, but potentially significant difference in the angle of Solar Orbiter relative to the Earth-Sun line.

Small equatorial coronal hole CH91/- in the western disc may give some weak enhancement in solar winds later today (08 Nov) or through Day 2 (09 Nov), but as this is a non-recurrent feature confidence is moderate. Slightly elevated solar wind speeds are considered most likely from this feature, but limited Geomagnetic effects are expected, given that it is a negative polarity coronal hole. MOSWOC's ENLIL model shows an initial significant enhancement from HSS influence to Elevated levels from CH88/+ , which is considered too early, even if Earth connects with a HSS from CH88 as this feature is quite a way south. If a connection were to occur then this may happen late Day 2 (09 Nov) or early Day 3 (10 Nov), bringing slightly elevated to elevated solar wind speeds.

Mainly Quiet to Unsettled (Kp 1-3) activity is expected, but with isolated Active (Kp 4) intervals likely due to occasional weak HSS and CME influences, with a slight chance of G1/Minor (Kp 5) geomagnetic storms until late day 3 (10th).

Geomagnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	30	30	30	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
2024-11-05 00:01	Partial	AR3883	SE	606	Late 07 or early 08 Nov	Chance of a glancing impact. Solar Orbiter (0.71AU) likely detected this CME around 07/0400 UTC.

Figure 2: MOSWOC Enlil

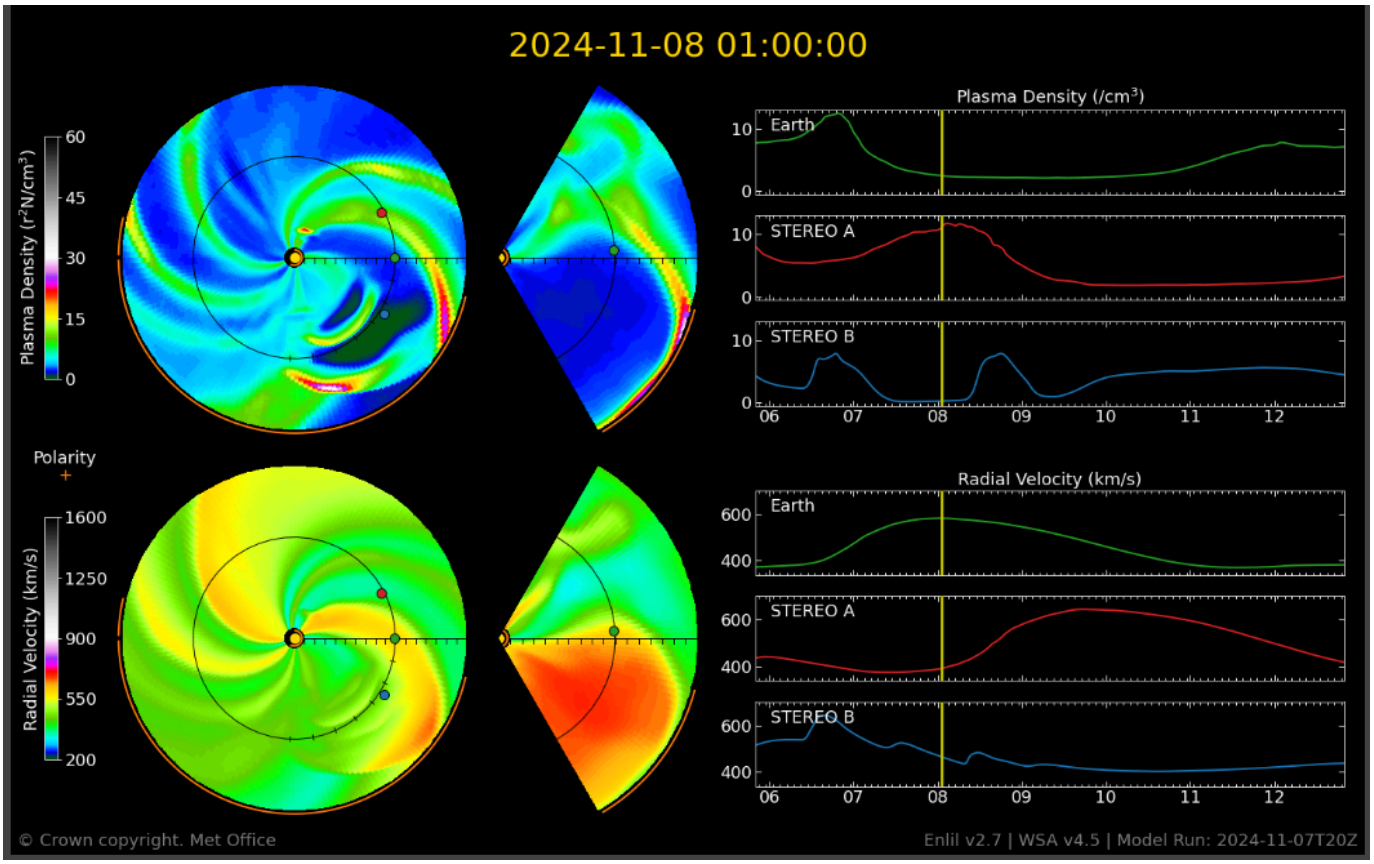

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Figure 3: MOSWOC Enlil Ensemble showing only minor perturbations and therefore low confidence in a CNE arrival today.

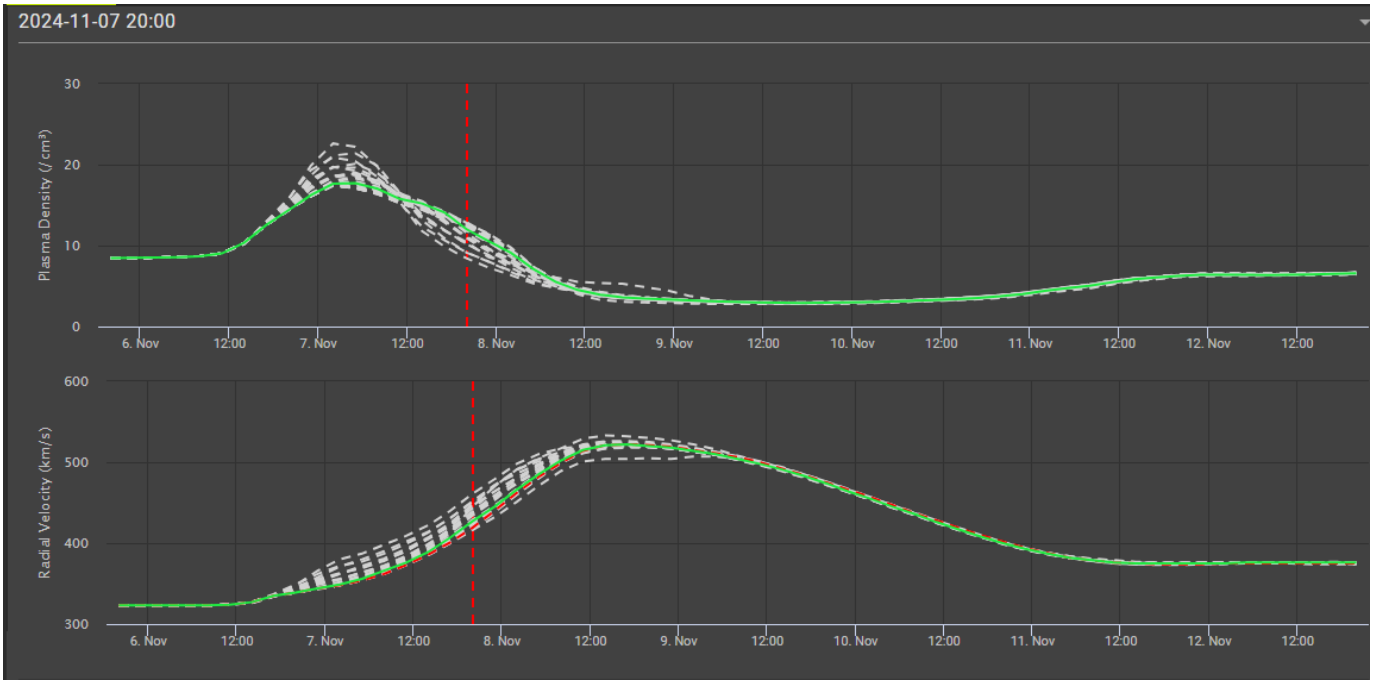

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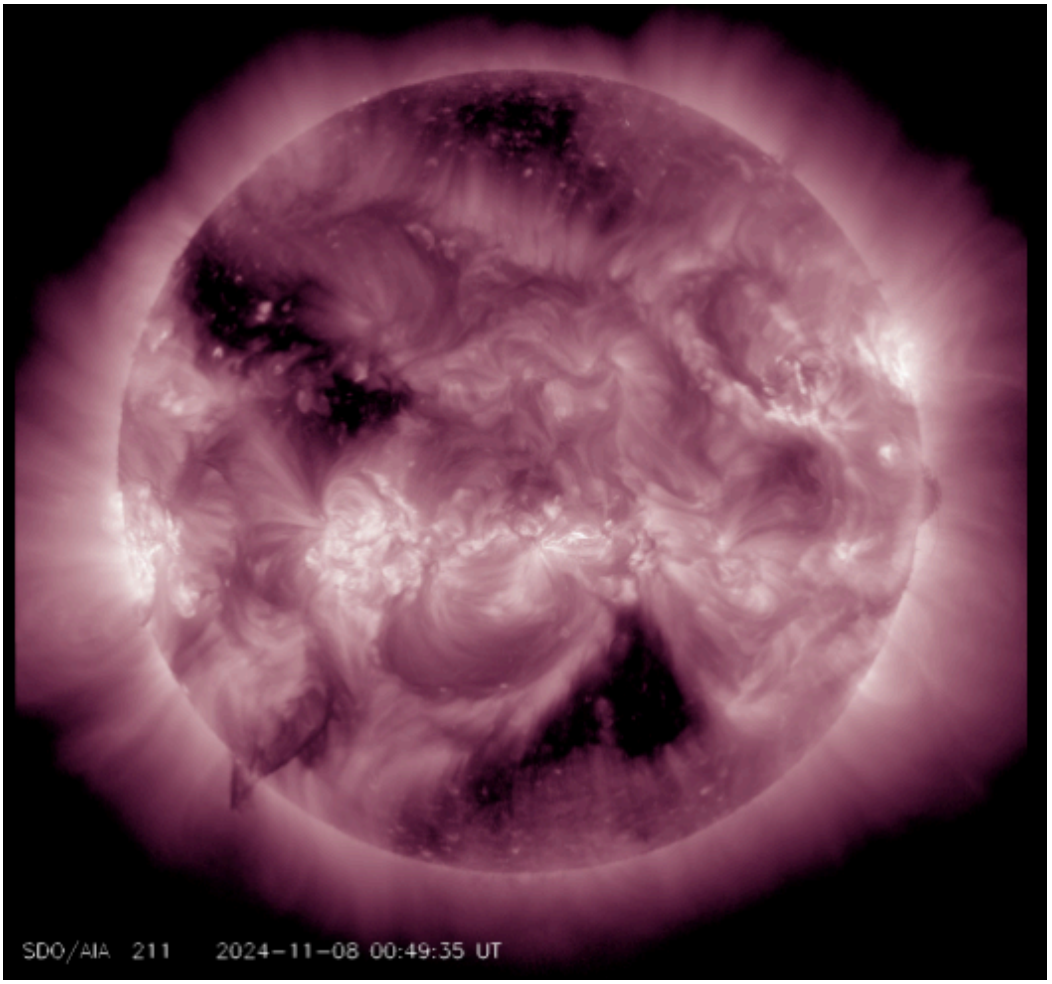
Figure 4: Latest SDO/AIA image, with CH88 clearly in the southern hemisphere and CH91 only a faint feature in the west.



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Radio Blackouts - X-Ray Flares

There are currently nine numbered sunspot regions on the visible disc, including one unnumbered group.

AR3883 in the centre-disc has seen some spreading of its interior spots, with differential movement indicating elevated magnetic shearing, but also some continued slight areal reduction. One small delta spot in the interior of the group persists, and the region is now classified as Fhi/beta-gamma-delta. AR3886, to the east of AR3883, has also decreased slowly in area, and is close to developing a small delta spot in a northern trailing portion. AR3889 in the far southeast appears to be a moderately-large group with a cluster of mature spots. It is still too foreshortened in available imagery to confidently determine its magnetic configuration, but it is likely to have a complex magnetic configuration with a potential delta spot. The remaining regions on the visible disc are smaller and magnetically simpler, generally either stable or only showing slight changes.

Moderate activity is forecast to continue, with occasional M-class flares expected and a chance of isolated X-class flares, with AR3883 and AR3889 currently the most likely sources.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	90	90	90	90
Very Active	R3-R5 (X Class)	No	25	25	25	25

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Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES-18 is at normal background levels. Many of the notable sunspots that currently occupy the facing-disc are currently located in centre disc or the eastern hemisphere. There is a slight chance of S1/Minor Proton Storms or greater on Days 1-2 (08-09 Nov), rising to a chance by Day 3 (10 Nov) as the significant regions rotate into more geo-effective positions on the visible disc.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	15	20	25
Very Active	**≥ S3 ***	No	1	1	1	0
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES16 is currently at background to Moderate levels, having briefly reached High levels on the 7th at the peak of the diurnal cycle.

The high energy electron flux is expected to remain at Background to Moderate at first, then increasing to predominantly Moderate levels later in the forecast period, perhaps temporarily touching High levels at the peak of diurnal cycles later in the period, due to HSS influence. The associated 24 hour fluence is expected to persist below Active levels, which corresponds with the guidance shown in the MOSWOC REFM output. Therefore the REFM model is considered to be showing reasonable guidance, although an increasing trend is preferred.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	5	10	20
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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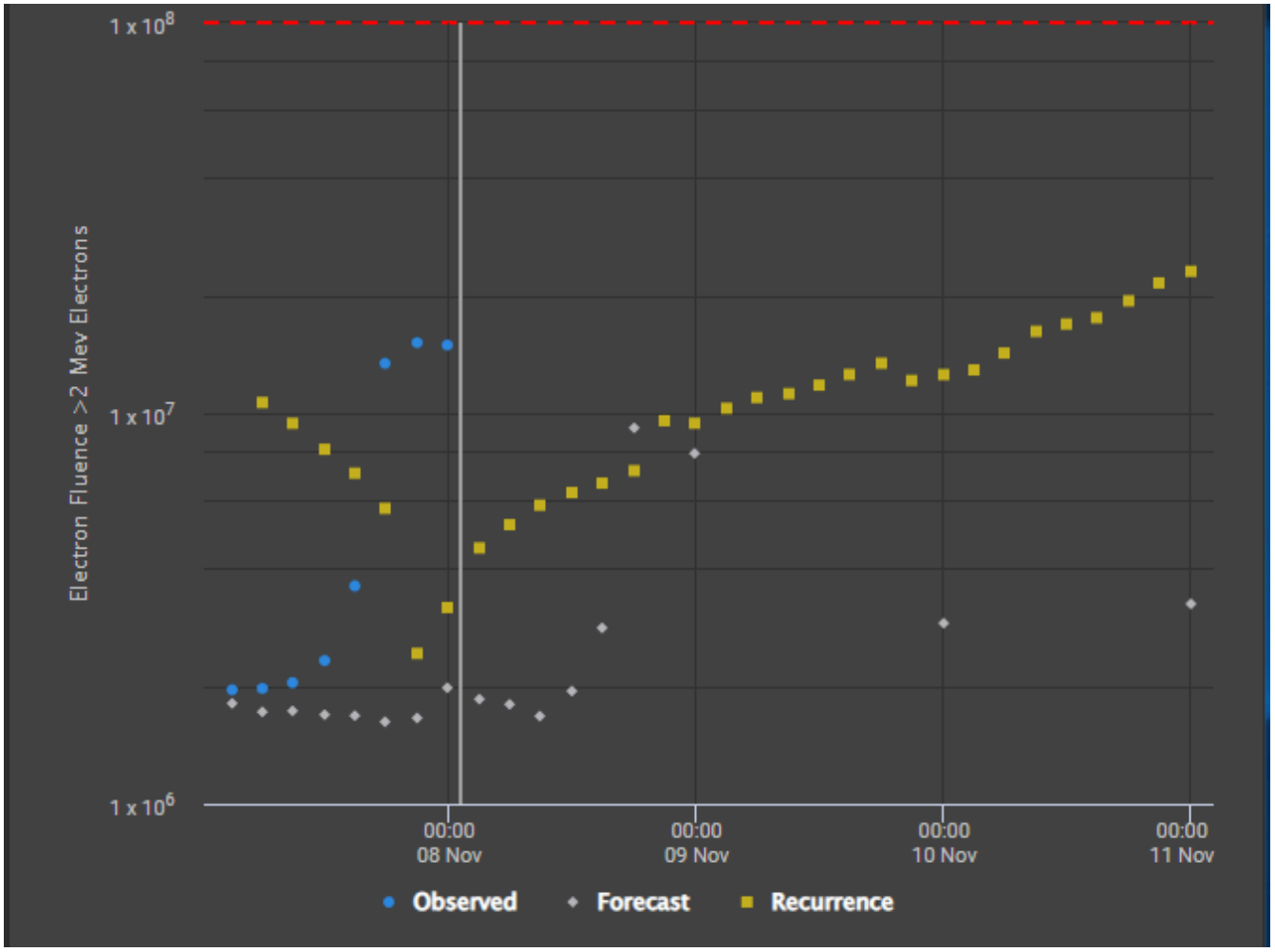
Figure 5: MOSWOC REFM



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